

We Claim:

1. A multiple-band antenna having first and second operating frequency bands, comprising:

a first patch structure associated primarily with the first operating frequency band;

5 a second patch structure electrically coupled to the first patch structure and associated primarily with the second operating frequency band;

a first slot structure disposed between a first portion of the first patch structure and the second patch structure and associated primarily with the first operating frequency band; and

10 a second slot structure disposed between a second portion of the first patch structure and the second patch structure and associated with the first operating frequency band and the second operating frequency band.

2. The multiple-band antenna of claim 1, wherein dimensions of the first patch structure, the first slot structure, and the second slot structure primarily determine the first operating frequency band, gain of the multiple-band antenna in the first operating frequency band, and impedance of the multiple-band antenna in the first operating frequency band.

20 3. The multiple-band antenna of claim 2, wherein dimensions of the second patch structure and the second slot structure primarily determine the second operating frequency band, gain of the multiple-band antenna in the second operating frequency

band, and impedance of the multiple-band antenna in the second operating frequency band.

4. The multiple-band antenna of claim 1, further comprising a feeding port, the
5 feeding port comprising:

a feeding point electrically coupled to the first patch structure and positioned to overlap the first patch structure; and

a ground point electrically coupled to the second patch structure and positioned to overlap the second patch structure.

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5. The multiple-band antenna of claim 1, wherein the first patch structure is a substantially C-shaped structure comprising a first end portion, a second end portion, and an adjoining portion coupling the first end portion and the second end portion, wherein the second patch structure is electrically coupled to the adjoining portion, wherein the
15 first slot structure is disposed between the first end portion and the second patch structure, and wherein the second slot structure is disposed between the second end portion and the second patch structure.

6. The multiple-band antenna of claim 5, further comprising:

20 a feeding point electrically coupled to the first end portion and positioned to overlap the first end portion; and

a ground point electrically coupled to the second patch structure and positioned to overlap the second patch structure,

wherein the feeding point and the ground point comprise a single feeding port of the multiple-band antenna.

7. The multiple-band antenna of claim 6, wherein the first patch structure further comprises a bent portion electrically coupling the feeding point to the first end portion, and the second patch structure comprises a bent portion electrically coupling the ground point to the second patch structure.

8. The multiple-band antenna of claim 7, wherein the bent portion of the first patch structure and the bent portion of the second patch structure respectively position the feeding point and the ground point at a predetermined distance from the first patch structure and the second patch structure.

9. The multiple-band antenna of claim 1, wherein the first operating frequency band is a Global System for Mobile communications (GSM) frequency band, and the second operating frequency band is a Digital Cellular System (DCS) frequency band.

10. The multiple-band antenna of claim 9, wherein the GSM frequency band is GSM-900, comprising a transmit sub-band of 880-915MHz and a receive sub-band of 925-960MHz.

11. The multiple-band antenna of claim 10, wherein the DCS frequency band comprises a transmit sub-band of 1710-1785MHz and a receive sub-band of 1805-1880MHz.

5 12. The multiple-band antenna of claim 1, further comprising a plurality of tuning structures.

13. The multiple-band antenna of claim 12, wherein the plurality of tuning structures comprises:

10 a first tuning structure connected to the first portion of the first patch structure and comprising a fine tuning tab for tuning the second operating frequency band; and

a second tuning structure connected to the second portion of the first patch structure and comprising a fine tuning tab for tuning the first operating frequency band.

15 14. The multiple-band antenna of claim 1, wherein the first patch structure and the second patch structure comprise electrically conductive material selected from the group consisting of: copper, aluminum, silver, and gold.

20 15. The multiple-band antenna of claim 1, implemented in a wireless mobile communication device selected from the group consisting of: data communication devices, voice communication devices, dual-mode devices enabled for both data and voice communications, cellular telephones, wireless email communication devices, mobile telephones having data communications functionality, personal digital assistants

(PDAs) enabled for wireless communications, wireless email communication devices, and wireless modems.

16. A multiple-band antenna system comprising:

5 a multiple-band antenna having first and second operating frequency bands, comprising:

a first patch structure;

a second patch structure electrically coupled to the first patch structure;

10 a first slot structure disposed between a first portion of the first patch structure and the second patch structure;

a second slot structure disposed between a second portion of the first patch structure and the second patch structure;

a feeding point electrically coupled to the first patch structure; and

15 a ground point electrically coupled to the second patch structure,

wherein the first patch structure, the first slot structure, and the second slot structure form major radiating and receiving structures for the first operating frequency band, and the second patch structure and the second slot structure form major radiating and receiving structures for the second operating frequency band; and

20 a mounting structure comprising:

a first surface; and

a second surface opposite to and overlapping the first surface,

wherein the first and second patch structures are mounted to the first surface, and wherein the feeding point and the ground point are mounted to the second surface.

- 5 17. The multiple-band antenna system of claim 16, wherein the multiple-band antenna further comprises mounting bores in the first patch structure, the second patch structure, the feeding point, and the ground point for receiving fasteners to mount the multiple-band antenna to the mounting structure.
- 10 18. The multiple-band antenna system of claim 17, wherein the mounting bores comprise offset mounting bores in the first patch structure offset from a surface of the first patch structure.
- 15 19. The multiple-band antenna system of claim 17, wherein the fasteners comprise mounting pins disposed on the first surface and the second surface of the mounting structure and positioned to be received by the mounting bores.
- 20 20. The multiple-band antenna system of claim 19, wherein the mounting pins comprise heat stakes that are melted to retain the multiple-band antenna on the mounting structure.
21. The multiple-band antenna system of claim 16, installed at a top rear portion of a wireless mobile communication device.

22. A wireless mobile communication device comprising:

a first transceiver adapted to transmit and receive communication signals in a first frequency band;

5 a second transceiver adapted to transmit and receive communication signals in a second frequency band; and

a multiple-band antenna connected to the first transceiver and the second transceiver and comprising:

a first patch structure associated primarily with the first frequency band;

10 a second patch structure electrically coupled to the first patch structure and associated primarily with the second frequency band;

a first slot structure disposed between a first portion of the first patch structure and the second patch structure and associated primarily with the first frequency band; and

15 a second slot structure disposed between a second portion of the first patch structure and the second patch structure and associated with the first frequency band and the second frequency band.

23. The wireless mobile communication device of claim 22, further comprising:

20 a housing substantially enclosing the wireless mobile communication device and having front, rear, top, bottom, and side surfaces,

wherein the multiple-band antenna is mounted in the wireless mobile communication device adjacent the top and rear surfaces.

24. The wireless mobile communication device of claim 23, further comprising a keyboard, a display, a speaker, and a microphone mounted within the front surface.

5 25. The wireless mobile communication device of claim 22, wherein the first frequency band is a Global System for Mobile communications (GSM) frequency band, and the second frequency band is a Digital Cellular System (DCS) frequency band.

26. The wireless mobile communication device of claim 22, further comprising:

10 a fine tuning tab connected to the first portion of the first patch structure for tuning the second frequency band; and

a fine tuning tab connected to the second portion of the first patch structure for tuning the first frequency band.

15 27. The wireless mobile communication device of claim 22, selected from the group consisting of: data communication devices, voice communication devices, dual-mode devices enabled for both data and voice communications, cellular telephones, wireless email communication devices, mobile telephones having data communications functionality, personal digital assistants (PDAs) enabled for wireless communications,
20 wireless email communication devices, and wireless modems.